

REMARKS

Reconsideration of the rejection of the subject matter of this application is requested.

Status of Claims

Claims 4-9, previously pending, and new claims 10-12, are presented consideration. Claims 1-3 have been canceled. The only remaining independent claims are new claim 10, drawn to a process for making optical fiber, and new claim 11, drawn to a process for making optical fiber preforms.

The Drawing

There appears to be no box checked for item 10 in the Office Action. Applicants presume the drawing is acceptable as filed.

Rejections On Prior Art

All the claims previously pending stand rejected under either 35 U.S.C. 102 or U.S.C. 103 as unpatentable in view of the Akira et al. reference.

Argument

Applicants' invention is characterized by at least two main aspects. The consolidation process is bifurcated into two steps. The core is consolidated first, then the cladding. With a consolidated core, and an unconsolidated (porous) cladding, the cladding may be doped with a gaseous fluorine compound without

substantially doping the core. Since this is inherently a selective doping process, the fluorine doping step must be done properly or else fluorine will reach and dope the core region. It is intuitively obvious that if the fluorine doping step is conducted for too long, or at a high temperature, unwanted doping of the core region inevitably occurs. The proper fluorine doping step depends primarily on two main parameters, time and temperature.

In the Akira et al. method, there is virtually no control over these doping parameters. This is due to the fact that the fluorine doping step and the consolidation step are done at the same time. Both of the important parameters just mentioned are dictated by the consolidation process, and therefore are far from optimum for the doping process. More specifically, the temperature is very high, typically greater than 1300 °C, to fuse the glass particles into a consolidated glass body. The time for the process is the time required for complete consolidation. Neither parameter is controlled independently of the consolidation requirements. Thus control over the fluorine doping step is seriously lacking, and varying the fluorine doping level, and/or the doping depth, is not possible.

Although few details are given, the conventional fluorine doping process is well known to be an equilibrium process. The doping step involves heating the porous body to a high temperature (e.g. 1400 °C), exposing it to SiF_4 or SiF_6 , and waiting for the reaction of SiO_2 and SiF_6 to occur. While the lengthy reaction times are not stated in the patent, they are notoriously well known. The equilibrium process also uses a partial pressure of fluorine that is described by the equilibrium equation:

$$\Delta n \sim p^{\frac{1}{4}}$$

The new independent claims specify that the fluorine doping step is performed by incremental doping. This is a new technique that is described and claimed in application Serial No. 09/755,914. The incremental doping process has these important distinctions. First, in the incremental doping process, a very large excess of F is predeposited on the silica particles at the F deposition temperature. The deposition temperature is below 1050 °C. At this relatively low deposition temperature, the process, including the overall deposition amount, is relatively well controlled. As deposition temperatures increase above 1050 °C, control of the process suffers. Therefore, goals of the incremental doping technique are to keep good process control, as well as to shorten the process. Shortening the process reduces the likelihood of unwanted fluorine doping of the core region, as discussed earlier. To shorten the process, F is deposited at low temperature (below 1050 °C) in very large quantities. These quantities are far larger than the equilibrium quantity where reaction between SiO₂ and SiF₆ is complete. Much of the F in this step is simply absorbed into the surface of the particles, not fully reacted. This process is illustrated in applicants' Figs. 6-9. In new claims 10 and 11, the only independent claims pending (and therefore in all of the pending claims) the excess of F results from a deposition step that uses a partial pressure of at least five times the equilibrium partial pressure. This is set forth in the passage beginning at line 11 on page 12 of applicants' specification. In terms of the equilibrium equation this would appear as:

$$\Delta n < 0.2 p^{\frac{1}{4}}$$

Another difference is the use of a drive-in step, the step that shortens the process, in an atmosphere that is devoid of F. Since the drive-in temperature is high, to promote diffusion of the excess F absorbed in the deposition step, further doping (doping in a relatively uncontrolled regime as described above) is avoided by removing the porous body from the fluorine atmosphere (or reducing the fluorine concentration). In the process described in Akiya et al. patent, the porous body is always heated in the fluorine compound atmosphere.

In the claims as now presented, the drive-in may occur in step (v), or there may be an added drive-in step. Limitation (iv) specifies that the fluorine is reduced or eliminated from the atmosphere during this step. This aids in overall control of the process. In new claim 12, fluorine is essentially eliminated from the atmosphere at this point.

In view of the amendments and these remarks, reconsideration and allowance of claims 4-12 is requested.

In the event that the Examiner concludes that a telephone call would advance the prosecution of this application, the Examiner is invited and encouraged to call the undersigned attorney at Area Code 757-258-9018.

Respectfully,



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